

## **Underwater Intelligent Sensor Protection System (UISPS)**

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Contract Number: N00014-99-C-0226  
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### **LONG-TERM GOALS**

The long-term goal is to develop an Underwater Intelligent Sensor Protection System (UISPS) to eliminate long-term bio fouling of underwater radiometers, which would make extended, unmanned radiometric measurements possible.

### **OBJECTIVES**

Implement final hardware and software modifications to the existing prototype system, verify performance by extended testing in laboratory, and deploy the system dockside at Woods Hole Oceanographic Institute.

### **APPROACH**

This device consists of segment of a sphere, which houses the radiometer. A spherical optical glass completes the sphere. The composite sphere rotates within a flexible circular aperture/scrapper, which is in light contact with the sphere. A cylindrical shell supports the sphere and the scraper. As the sphere rotates past the scraper, the bulk of the contaminants are removed. Continuing the rotation brings the optical window (and the rest of the sphere) into a cleaning solution and past a set of brushes and squeegees within the cylindrical shell. The cleaning cycle is complete when the sphere completes one full revolution and the optical glass reaches the 12 o'clock position again.

The frequency of cleaning, number of rotations per cleaning cycle, data sampling rate and frequency, and all other data acquisition and control parameters are adjustable for greater flexibility of the device. A bi-axial inclinometer has also been implemented within the sphere to provide reference tilt data.

During long term testing, an unprotected radiometer adjacent to UISPS will be used to verify the contamination extent as well as data.

Report Documentation Page			Form Approved OMB No. 0704-0188		
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1. REPORT DATE <b>30 SEP 2003</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2003 to 00-00-2003</b>	
4. TITLE AND SUBTITLE <b>Underwater Intelligent Sensor Protection System (UISPS)</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Scientific Solutions Inc.,99 Perimeter Road,,Nashua,,NH, 03063</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT <b>The long-term goal is to develop an Underwater Intelligent Sensor Protection System (UISPS) to eliminate long-term bio fouling of underwater radiometers, which would make extended, unmanned radiometric measurements possible.</b>					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>4</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

## **WORK COMPLETED**

Following tests conducted at Woods Hole Oceanographic Institute last year, the need for a series of modifications and improvements became necessary. The modifications being implemented are two fold. First, the glass window is being mechanically retained rather than being bonded to the sphere as long-term exposure to seawater softened the bond in the previous design. Second, the scraper is now flexible and in light contact with the sphere, thus conforming to the spherical surface and reducing the possibility of any small particles to lodge themselves in the small gap between the scraper and the sphere. Furthermore, with a soft scraper design, any entrapped particles would simply deform the scraper or fall through into the cleaning solution reservoir within the housing, thus eliminating the chance of damage to the optical window, or jamming of the device. These improvements have been designed, manufactured, assembled, and are currently being tested in the water tank at SSI's laboratory. Deployment of the system off Woods Hole Oceanographic Institute's dock is currently being scheduled. The main computer for data acquisition and control, the interface printed circuit board and all other electric and electronic components exist and are in working order.

## **RESULTS**

The system is currently undergoing testing at SSI, and its operation is being monitored via the World Wide Web. Currently, all software and hardware systems seem operational. Despite the premature failure of the system during the previous round of testing at WHOI, and severely bio fouled housing, the glass window and the sphere were clean when the system was recovered for modifications.

## **IMPACT/APPLICATIONS**

This system will considerably enhance the quality of the underwater radiation measurements and reduce hardware maintenance costs by keeping the sensor clean and free of biological growth. Furthermore, the longevity of measurements will be greatly improved in comparison to current deployments.

## **TRANSITIONS**

The system will be utilized by researchers as part of an existing mooring along with other oceanographic instruments, or as a standalone unit to make long-term underwater radiometric measurements.

## **RELATED PROJECTS**

During the deployment phase of the SHEBA program in September 1997, SSI personnel deployed eight of the Arctic ISPS [1] units in satellite sites as far as 50 Km from the main ice camp. These units worked flawlessly for one full year, as intended. In October 1998, they were recovered, and one site re-deployed. Further information and deployment photographs are available on SSI's web page [2].

A marine version of the ISPS has also been developed and tested aboard WHOI's R/V Oceanus. This version was intended to be integrated into the meteorological sensor package as part of the Moriah program.

## REFERENCES

1. Stein, P. J., A. Bahlavouni, D. Andersen, 1997, Intelligent Sensor Protection System, Final Report, ONR Phase II SBIR
2. <http://www.scisol.com>

## Publications

1. “Intelligent Sensor Protection System for Polar Environments”, Dr. Peter J. Stein, Armen Bahlavouni and Douglas W. Andersen (1997, *Sea Technology* feature article, February 2000)
2. “Intelligent Sensor Protection System for Polar and Marine Environments” Dr. Peter J. Stein, Armen Bahlavouni, and Douglas W. Andersen, (Proceedings of the Seventh International Offshore and Polar Engineering Conference, Honolulu, HI; May 25-30, 1997)

## Patents

“Weatherproofing Sensing Apparatus with Rotable Sensor”, with Dr. Peter J. Stein, Douglas W. Andersen, and Michael G. Fitzgerald (Patent No. 5,591,907 dated January 1997) [granted].